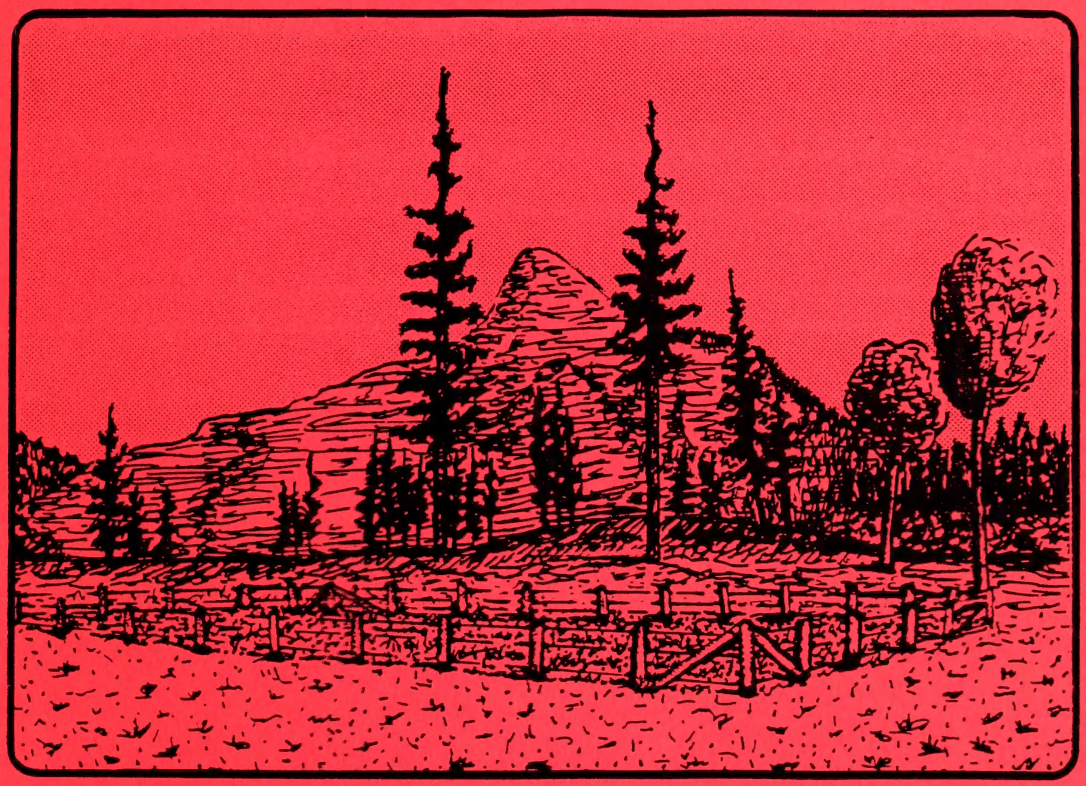
RANGELAND REFERENCE AREAS

CARBONDALE RIVER RANGE CONDITION AND TREND FROM 1953-1995



Alberta

ENVIRONMENTAL PROTECTION

RANGELAND REFERENCE AREAS

CARBONDALE RIVER

RANGE CONDITION AND TREND FROM 1953-1995

prepared by

Michael G. Willoughby

Edmonton
1997

Environmental Protection
Land and Forest Services

Pub. no.: T/357
ISBN: 0-7732-5113-8

For copies of this report contact:

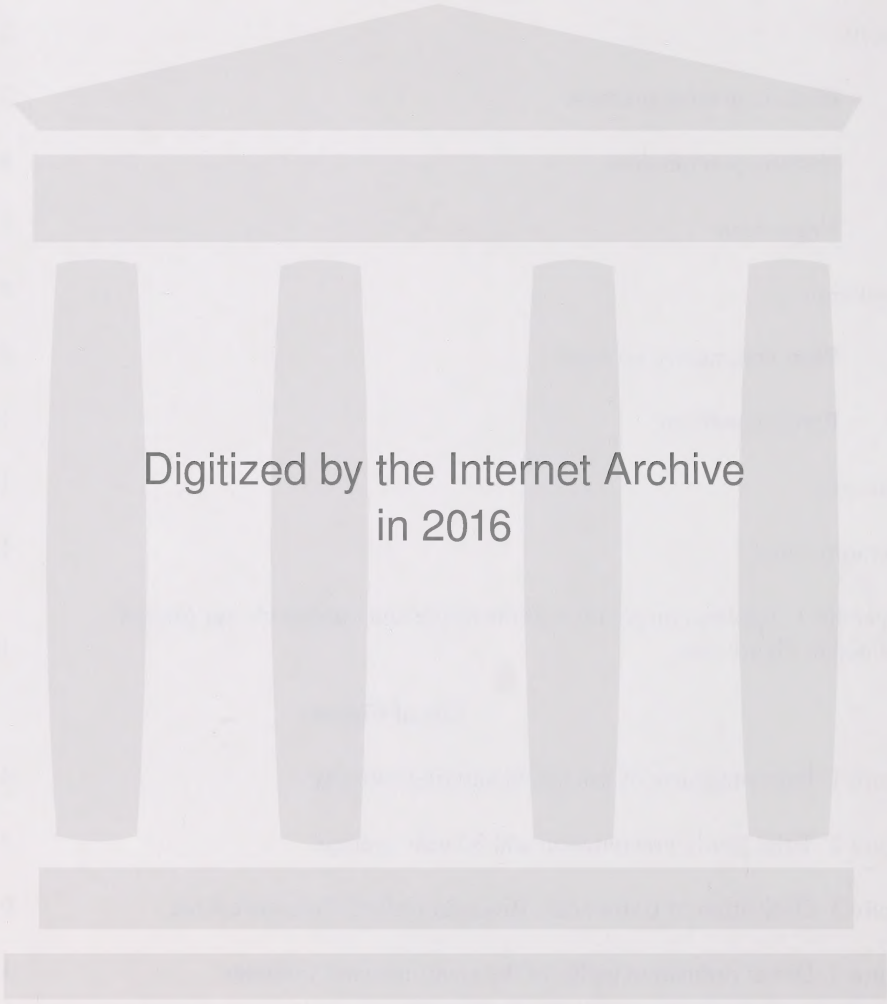
Michael Willoughby
9920 108th St.
Edmonton, Alta
T5K2M4
(403) 422-4598

E-mail: mwilloug@env.gov.ab.ca

Photo 1. Overview of the Carbondale River Rangeland Reference Area.

Table of contents

List of Figures



List of Tables

List of Photos

ABSTRACT

The Rangeland Reference Area program administered by the Land and Forest Service was established by the Eastern Rockies Forest Conservation Board to assess range condition and monitor trend on rangelands within the boundaries of the Rocky Mountain Forest Reserve (RMFR). Forty-five fenced exclosures have been established in the Forest Reserve. These exclosures include permanently marked grazed and ungrazed transects. Species composition data has been recorded on these transects since 1953 when many of the sites were established. Recently, the data of these sites has been analyzed in order to determine the successional pathways in the presence and absence of grazing. This long-term data used in conjunction with a detailed ecological classification of the range community types will help to determine the health of the forested rangelands in the province.

This report evaluates and discusses the range condition and trend of the Carbondale River Rangeland Reference Area. This reference area was established in 1953 on a glacial moraine which was thought to be in poor range condition. It is located within the Montane subregion and is part of the group of community types represented by the rough fescue ecosite (Willoughby et al. 1997).

INTRODUCTION

In the late 1800's livestock grazing was unregulated along the eastern slopes of the Rocky Mountains in Alberta. In an effort to protect the Saskatchewan River basin watershed the Rocky Mountain Forest Reserve was established in 1910. At this time grazing by domestic animals was prohibited. However, by 1913 grazing by livestock was recoqnized as a useful tool to reduce forage accumulation and assist in preventing a potential fire hazard. Due to inadequate management policies and funding, water quality continued to deterioate because of fire and localized overgrazing. As a result, the Rangeland Reference Area Program of the Alberta Forest Service was established in 1949 to assess range condition and monitor range trend on grasslands within the boundaries of the Rocky Mountain Forest Reserve (Hanson 1975). Fourty-five reference areas have been established in the Reserve. Many of these sites have been monitored since 1953.

This report discusses and evaluates the range condition and trend of the Carbondale River Rangeland Reference Area. The reference area was established in 1953 on a glacial moraine which was thought to be in poor range condition. Associated with the reference area are 3 transects, one inside and two outside. The location of the original outside transect was considered inappropriate for proper paired plot comparison, so in 1983, another transect was established outside the exclosure.

SITE DESCRIPTION

The Carbondale River Reference Area is part of the primary rangelands in the Montane subregion of Alberta (Dept. of Environmental Protection 1994). The Montane subregion composes only 0.9% of the province and is found in an area south of Chain Lakes to the Montana border, portions of the Bow and Athabasca river valleys and isolated areas near Ya Ha Tinda and Grande Cache. The Montane is distinguished from the other subregions by the presence of Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis)* and lodgepole pine (*Pinus contorta*). Elevationally the Montane occurs below the Subalpine in the mountains and above the Foothills Fescue and Foothills Parkland subregions in southern Alberta.

Yearly precipitation ranges 308 mm to 1279 mm with two precipitation peaks occurring in May-June and again in August-September (Strong 1992). Summer monthly temperatures average 11.9°C and are 2°C warmer than the Subalpine and 2°C colder than the Foothills Fescue subregions. The Montane has the warmest winter temperatures of any forested subregion in Alberta. This is due to the montane's association with the major east-west mountain valleys. The valleys are warm during winter as they channel warm modified Pacific air into Alberta and often escape outbreaks of cold arctic air from the north (Strong 1992).

In the Montane the modal grassland vegetation occurs on terraces and southerly facing slopes. The dominant grass species include rough fescue (*Festuca scabrella*), Parry oatgrass (*Danthonia parryi*), Richardson needlegrass (*Stipa richardsonii*), Idaho fescue (*Festuca idahoensis)*, upland sedge species and bluebunch wheatgrass (*Agropyron spicatum*). Moss and Campbell (1947) believed the rich flora of this subregion could be explained in terms of the continuity with the Palouse prairie through mountain passes from the Northwestern United States.

Many species characteristic of the Palouse prairie are found in southwestern Alberta: Idaho fescue, bluebunch wheatgrass, sticky purple geranium (*Geranium viscosissimum*), woolly gromwell (*Lithospermum ruderale*), and balsamroot (*Balsamorhiza sagittata*). The Carbondale River rangeland reference area appears to represent a disturbed rough fescue dominated community type on a south facing with a morainal parent material and Dk. Grey Chernozem soil (Weerstra 1989)(Photo 1). The inside ungrazed transect was classified as a Rough fescue-Idaho fescue-Parry oatgrass community type and the grazed outside transect was classified as a Kentucky bluegrass-Rough fescue community type (Willoughby et al. 1997).

METHODS

Reference sites were selected from within range allotments on areas that represented primary range. Originally sites thought to be in poor range condition were selected. These sites were usually represented by open grasslands on south-facing slopes, benchlands and terraces. The reference sites were not located near salt or within 100-ft. (30-m) of a fence. The preferred distance from a water source was greater than 1000-ft. (300-m) but less than 1-mi. (1.6-km).

Each reference site consisted of a fenced exclosure and a 100-ft (33-m) transect inside and outside the exclosure. The outside transect was situated 25-ft (8-m) or greater from the edge of the exclosure. At 3-in. (7-cm) intervals, the basal frequency of the plant species were recorded using Parker's loop (Parker 1954). In 1982, the canopy cover of the plant species was also recorded (at 6-ft. (1.8-m) intervals) using a 20x50 cm Daubenmire frame. Presently, the transects are being recorded every three years. All the basal frequency data prior to 1982 was converted to canopy cover using regression analysis. The regression equation for the Carbondale River reference area is (COVER)=0.8 + 0.89(FREQ), R^2=65, p>.0001.

This reference area was established in 1953 on a south facing slope with morainal parent material adjacent to the Carbondale River. The reference area is located in the North Carbondale distribution unit (D.U.) of the Castle River allotment.

A combination of of both ordination (DECORANA) (Gauch 1982) and cluster analysis (SAS) were used to group the inside and outside transects of different years. These techniques combined the sites based on the similarity of species composition. The groupings from cluster analysis were overlain on the site ordination. The number refers to the year the transect was recorded, the (i) refers to inside (ungrazed), the (o) to the outside (grazed).

Mean grazing pressure for each year was assessed by comparing annual utilization to the rated carrying capacity of the allotment and distribution unit. Total yearly AUM (Animal Unit Months) useage from the inception of the allotment was divided by the calculated carrying capacity for the allotment (AUM) and multiplied by 100. For example a number of 100 would indicate proper utilization.

The transects were also subjected to CANOCO (Ter Braak 1986) in an effort to relate community composition with known environmental variation. The environmental variables included percentage utilization, precipitation and grazing-precipitation rate. The grazing-precipitation rate was calculated by subtracting utilization level from the total annual precipitation in millimeters. A higher number would indicate lower grazing levels and higher precipitation.

RESULTS

Historic grazing pressure

Range use on the Carbondale River allotment and North Carbondale distribution unit has averaged over 145% of calculated carrying capacity since 1947 when records were first kept (Figure 1). Range use around the reference area has averaged 153% of calculated carrying capacity through the 1940's, 50's, 60's and 70's. Use declined somewhat during the 1980's averaging 124% of calculated carrying capacity. Since 1990 use has declined only slightly to 120% of calculated carrying capacity. The distribution unit is utilized by cow/calf breeding herds and has generally been grazed for the entire season.

Historic precipitation

Total yearly precipitation and the 30 year average for Beaver mines Meterological station, 5 miles south of the reference area is outlined in Figure 2. The 1940's, 50's and 60's had precipitation levels near normal. Only 3-4 years in each decade had precipitation levels below the 30 year average of 645 mm. In contrast the 1970's had 6 years with below average precipition and the 1980's was the driest decade on record. Eight of the ten years had below normal precipitation and the average for the whole decade was 567 mm. To date precipitation has been well above normal for the 1990's averaging well over 700 mm.

Vegetation

The ordination of the Carbondale River Rangeland Reference Area with years grouped by cluster analysis is outlined in Figure 3. The first two axes in the ordination accounted for 42% and 17% of the variation in the species stand table, respectively. There is a distinct grouping of the inside transects from 1980 to 1995 and the outside transect in 1995 (Group 3), the outside transects from 1980 to 1989 (Group 1) and outside and inside transects from 1953 to 1976 (Group 2).

The transects in group 2 were mathematically more similar to group 3 transects than group 1 transects according to cluster analysis. Group 2 clustered with group 3 at a semipartial R^2 of 0.12. In contrast group 1 clustered with group 2 and 3 at a semipartial R^2 of 0.45. The new outside transects were very similar to groups 2 and 3 and grouped together at a sempartial R^2 of .03. These transects were not included in Figure 1 because there has been insufficient time to properly assess the trend.

The inside transects from 1980-1995 (Group 3) represent a plant community that has been protected

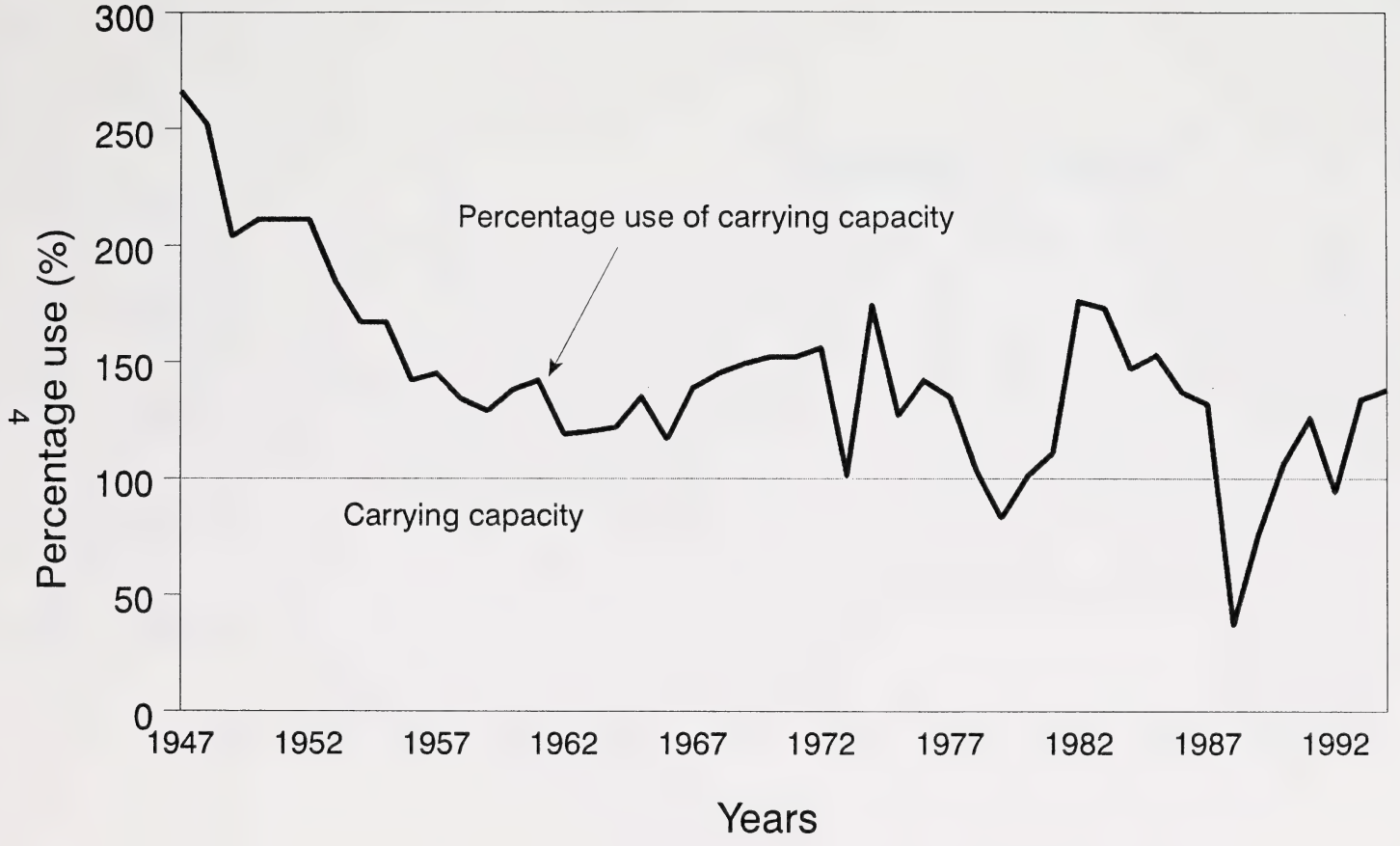


Figure 1. Percentage use of calculated carrying capacity for the Castle River allotment-North Carbondale distribution unit (D.U.).

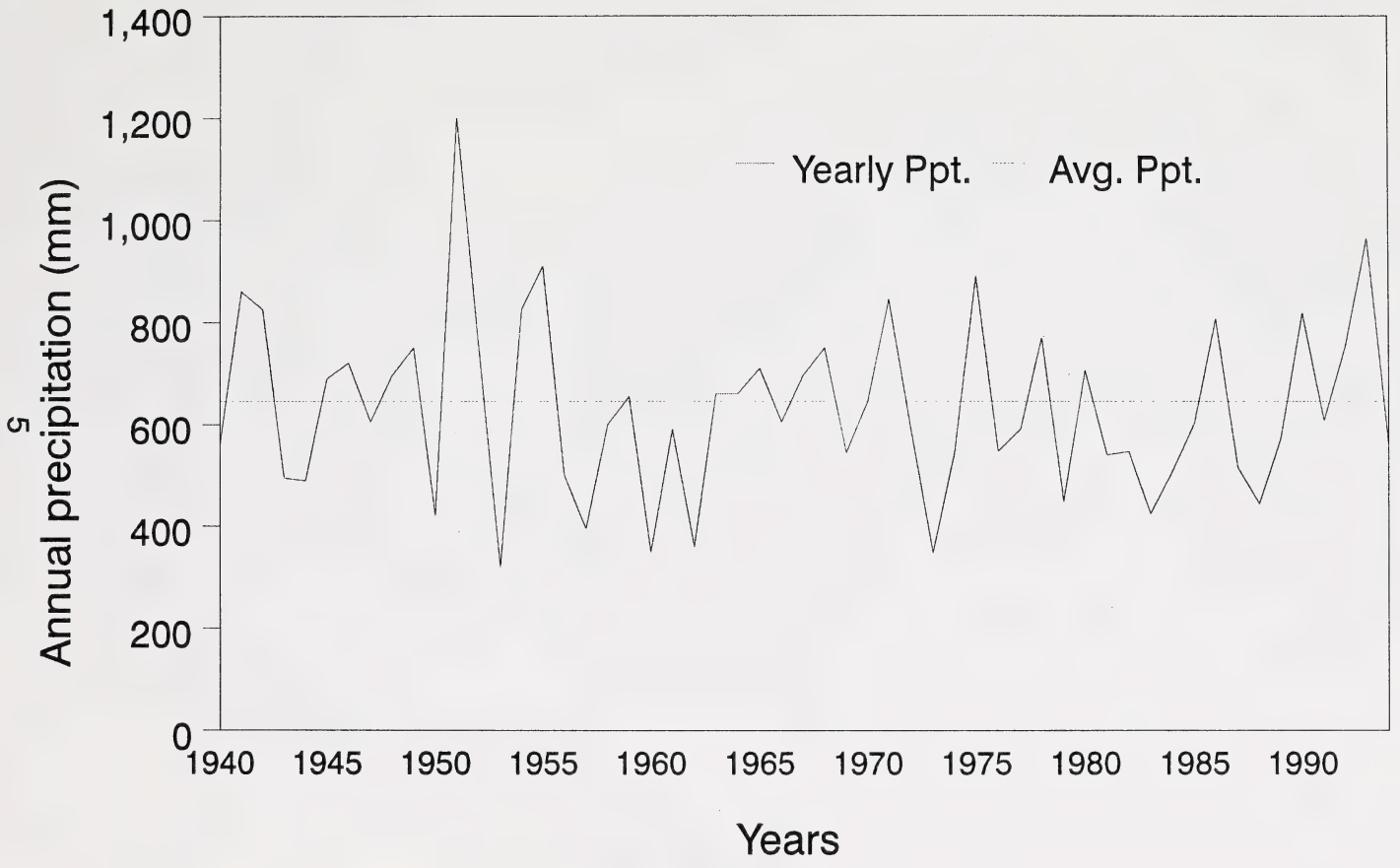


Figure 2. Total yearly precipitation and 30 year average for Beaver Mines Meteorological Station. Source. Canada, Department of the Environment, Monthly Meteorological Records.

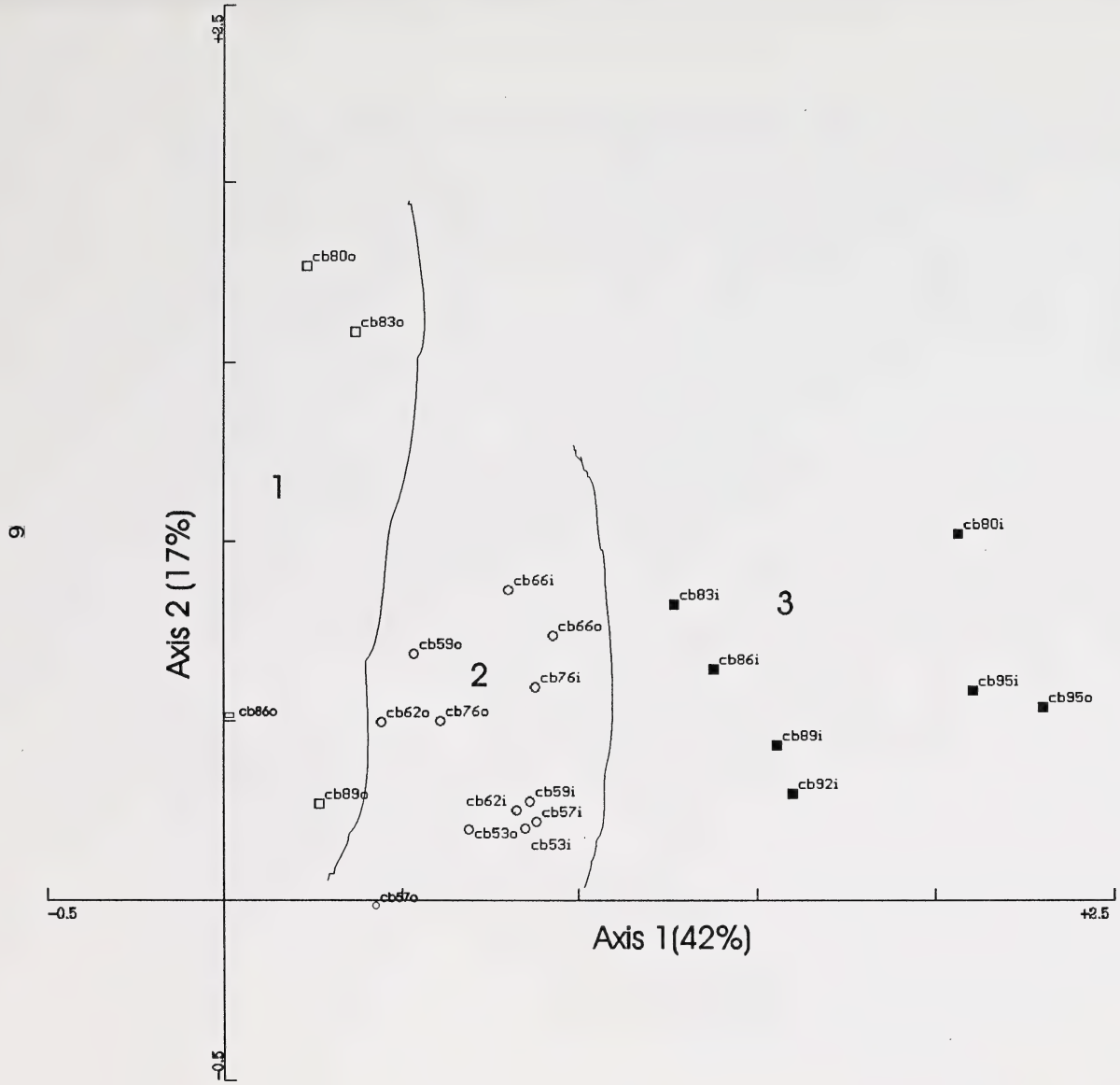


Figure 3. Ordination of Carbondale River rangeland reference area with years grouped by cluster analysis (i=inside, o=outside).

Table 1. Canopy cover (%) of the dominant species for Groups 1,2 and 3 as outlined in Figure 3 at the Carbondale River Rangeland Reference area.

Species	In&Out(2) 1950s-70s	Outside(1) 1980s	Inside(3) 1980-90s
Forbs			
LITTLE CLUBMOSS (*Selaginella densa*)	11B	45A	1C
NORTHERN BEDSTRAW (*Galium boreale*)	2A	2A	4A
OLD MAN'S WHISKERS (*Geum triflorum*)	1A	1A	5A
YARROW (*Achillea millefolium*)	1A	2A	3A
SILKY LUPINE (*Lupinus sericeus*)	TA	2A	3A
CUT LEAVED ANEMONE (*Anemone multifida*)	1C	2B	7A
WOOLY EVERLASTING (*Antennaria lanata*)	TB	TB	1A
PRAIRIE SAGEWORT (*Artemisia ludoviciana*)	TA	-A	2A
GOLDEN ASTER (*Heterotheca villosa*)	1B	5A	TB
Grasses			
IDAHO FESCUE (*Festuca idhaoensis*)	12A	6B	9B
BLUNT SEDGE (*Carex obtusata*)	9A	2A	4A
KENTUCKY BLUEGRASS (*Poa pratensis*)	TA	2A	8A
RICHARDSON'S NEEDLEGRASS (*Stipa richardsonii*)	3B	1B	5A
ROUGH FESCUE (*Festuca scabrella*)	2A	TA	7A
CALIFORNIA OATGRASS (*Danthonia californica*)	4A	2A	8A
JUNEGRASS (*Koeleria macrantha*)	5A	2AB	1B

*Means with the same letter indicate a significant difference at the p= 0.05 level according to an Lsmeans test.

from grazing for more than 27 years. These transects represent a community type that is dominated by rough fescue, Kentucky bluegrass, Idaho fescue and California oatgrass (Table 1)

In contrast the inside and outside grazed transects from 1953 to 1976 (Group 2) were dominated by Little clubmoss, Idaho fescue, sedge and Junegrass and represented an Idaho fescue-Sedge/Little clubmoss community type(Table 1). From 1980 to 1989 the outside transects (Group 1) were dominated by Little clubmoss and Idaho fescue. There was little cover of any other forbs and grasses in this group of transects.

Table 2 outlines the change in canopy cover of the dominant species on the inside and outside transects from 1953 to 1995. Idaho fescue, sedge, California oatgrass, little clubmoss cover have declined, whereas, rough fescue, Kentucky bluegrass and forbs (northern bedstraw, old man's whiskers, cut leaved anemone, prairie sagewort) have increased in the absence of grazing. There is a similar trend to the species composition on the grazed outside transect. Little clubmoss increased in cover up until 1989 but has declined rapidly in the 1990's. Old man's whiskers and Kentucky bluegrass cover has increased dramatically on the outside transect and rough fescue cover was not recorded on the 1995 transect.

The new transect established on the outside of the reference area in 1983 has not changed in species composition from 1986 to 1995. This transect is dominated by Kentucky bluegrass, Idaho fescue, California oatgrass, yarrow and old man's whiskers (Appendix 1). Rough fescue cover has remained at 1% for the four years the transect has been read. The species composition of this new transect is very similar to the 1995 inside and old outside transects. Although, the cover of rough fescue is higher on the inside transect compared to the two outside transects.

The species-environmental biplot from CANONICAL analysis (Figure 4) indicates that Kentucky bluegrass and old man's whiskers cover was higher in years with higher precipitation. In contrast rough fescue, California oatgrass and old man's whiskers were located around the ordinates of rate. A higher rate indicates lower grazing utilization and higher precipitation. Little clubmoss, junegrass and golden aster were more closely associated with low precipitation and higher utilization levels or a lower rate and therefore are associated with the ordinates of utilization and the lower ends of the line for rate and precipitation.

DISCUSSION

Plant community ecology

The Carbondale River rangeland reference appears to be on the drier end of the gradient of rough fescue dominated community types. When the site was first established the inside and outside transects were both very similar and represented a Idaho fescue-Sedge/Little clubmoss community type. When the site was protected from grazing for 36 (1989) years it succeeded to a rough fescue dominated community type. Moss and Campbell (1947) and Willoughby (1992) found that rough fescue grows almost to the exclusion of other plants in the absence of disturbance. The buildup of litter inside the exclosure would favour the retention of water, particularly during the drought period of the 1980's (Irving 1992). This would allow the site to maintain its mesic moisture regime. Since 1989, moisture conditions have been more favourable

Table 2. Change in canopy cover (%) of selected species on the grazed (Out) and ungrazed (In) transects from 1953 to 1995 at the Carbondale River rangeland reference area.

	In					Out				
Species	1953	1966	1976	1989	1995	1953	1966	1976	1989	1995
Forbs										
LITTLE CLUBMOSS	5	11	12	6	0	8	9	16	57	0
NORTHERN BEDSTRAW	2	-	1	1	4	3	9	1	4	4
OLD MAN'S WHISKERS	2	-	1	5	5	3	1	1	T	10
YARROW	2	-	-	3	2	2	1	1	2	4
SILKY LUPINE	-	1	-	3	1	-	2	-	2	3
CUT LEAVED ANEMONE	2	-	1	13	4	1	-	2	6	1
WOOLY EVERLASTING	-	-	-	2	1	-	-	-	-	1
PRAIRIE SAGEWORT	-	-	1	2	3	-	-	-	-	-
GOLDEN ASTER	-	-	-	-	-	3	-	-	10	-
Grasses										
IDAHO FESCUE	10	6	17	9	9	8	12	19	19	12
BLUNT SEDGE	13	1	8	2	5	11	2	6	5	8
KENTUCKY BLUEGRASS	-	-	-	T	15	-	2	-	1	20
RICHARDSON NEEDLEGRASS	5	1	1	8	4	4	1	-	3	-
ROUGH FESCUE	1	8	4	14	14	-	5	2	1	-
CALIFORNIA OATGRASS	3	3	11	6	1	1	3	7	3	4
JUNEGRASS	7	2	5	1	-	5	1	11	3	1
Species number	16	9	19	30	33	18	16	22	30	30

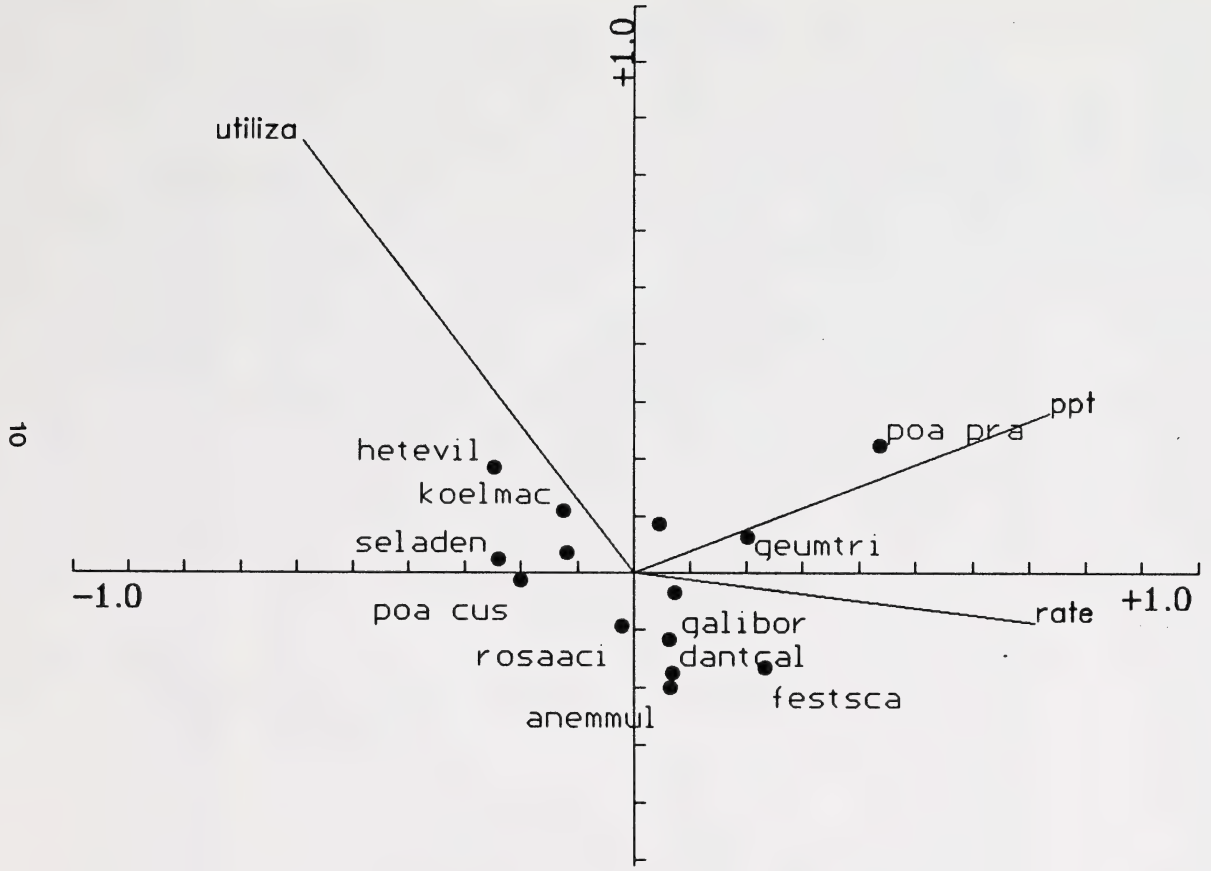


Figure 4. Direct ordination (CANOCO) biplot of the environmental variables (precipitation, utilization, precipitation-utilization rate) and species whose weight in the analysis was greater than seven.

and the undisturbed inside transect has been invaded by Kentucky bluegrass from outside the exclosure. The inside transect now appears to be undergoing succession to a Rough fescue-Kentucky bluegrass dominated community type.

In contrast, the continued heavy grazing pressure at the reference area coupled with lower precipitation in the 1970's and 80's caused the grazed transect to move to a Little clubmoss/Idaho fescue dominated community type. The heavy grazing pressure on the outside transect reduced litter cover and the moisture of the site would have been much lower than inside the exclosure. As a result, during the 1980's there was little cover of forbs and grass on the outside transect.

The moisture conditions during the 1990's have been much more favourable and Kentucky bluegrass has become dominant on the outside grazed transect to form a Kentucky bluegrass-Idaho fescue dominated community. There has also been a corresponding increase in forb and grass cover and a decline in the cover of little clubmoss.

Range condition

Traditionally, range condition has been defined by comparing species present with species of the climax community (Dyksterhuis 1949, Wroe et al. 1988). This climax range condition model suggests that vegetation will be directional, predictable and revert back to the original rough fescue dominated predisturbance plant community in time. When the Idaho fescue/Little clubmoss community type was protected from grazing it appears to succeed back to a rough fescue dominated grassland. Consequently, the inside grazed transect would have been in good to excellent condition in 1989.

However, when drought and grazing pressure are applied to the community type the traditional range condition model does not apply and the vegetation dynamics closely follow the state and threshold model (Laycock 1991). Heavy grazing pressure and drought move the community to one dominated by xeric plant species (little clubmoss, junegrass, golden aster, fringed sage). Under more favorable moisture conditions the site is quickly invaded by Kentucky bluegrass. It seems that both models apply to the vegetation dynamics of this site (Figure 5).

The current dilemma on which system best describes range condition has led the Task Group on Unity in Concepts and Terminology (1995) to propose that ecological site and desired plant community concepts be used to assess the status of rangelands. Ecological site is defined as "a kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management". The undisturbed transect at the Carbondale reference area has succeeded to a community that is dominated by rough fescue and Kentucky bluegrass. This community type has been quite stable for the last 6 years (Table 2) and it seems unlikely the site will return to a community that is dominated solely by native plant species. Under grazing pressure the ecological conditions of the site are very drought sensitive. Continued heavy grazing pressure during the drought of the 1980's led to a plant community that was dominated by little clubmoss and was in very poor condition.

The desired plant community is defined as "of the several plant communities that may occupy a site, the one that has been identified through a management plan to best meet the plan's objectives for the site". The desired plant community for the Carbondale River rangeland

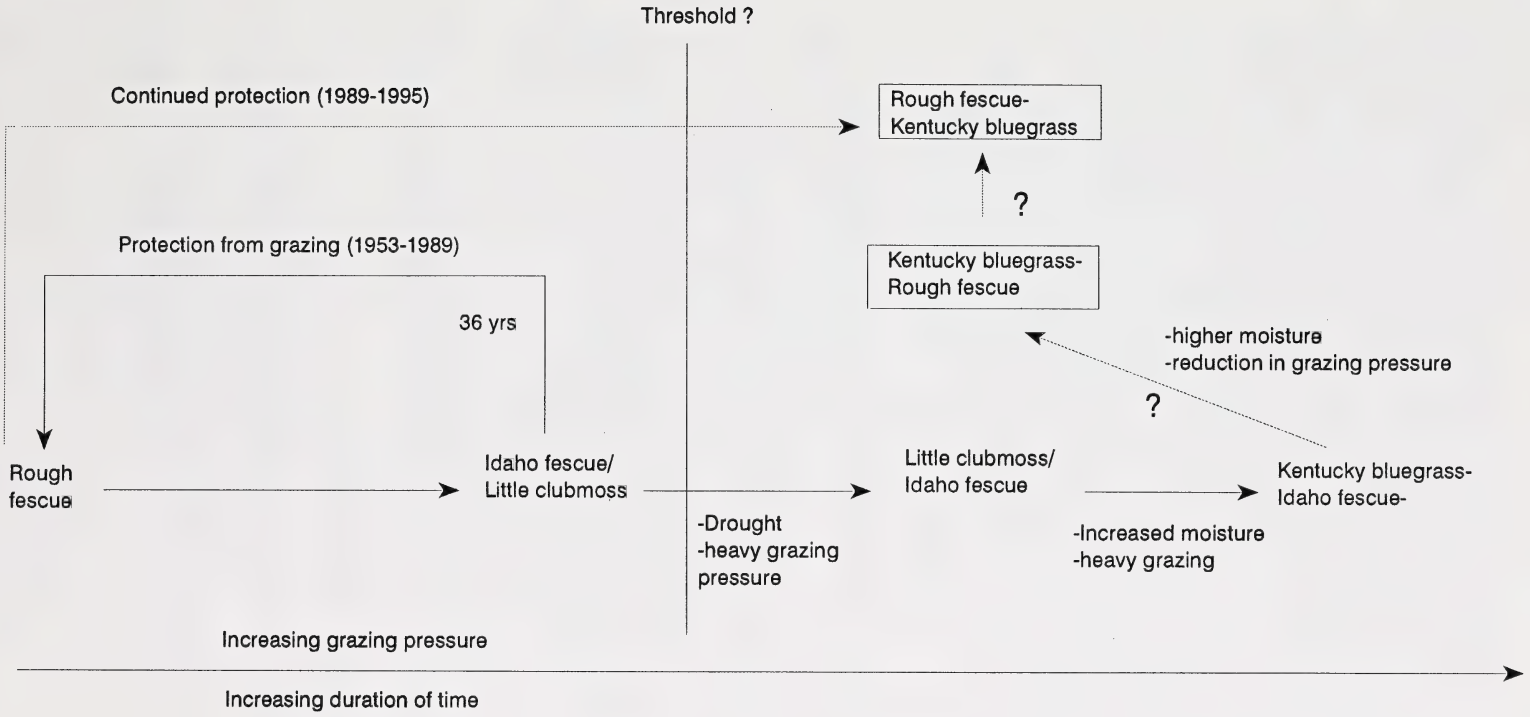


Figure 5. Successional changes in the presence and absence of grazing disturbance at the Carbondale River rangeland reference area.

reference area should be a community that remains stable under continued grazing stress during periods of drought. The Idaho fescue/Little clubmoss community type that represented the site in the 1950's, 60's and 70's appears to be unstable. Under grazing pressure continued drought in the 1980's moved this community type to one dominated by little clubmoss a very unproductive community type. In contrast, the rough fescue dominated community type inside the exclosure remained stable through this same drought period. It would appear that the desired plant community for this site would be a rough fescue dominated community that had a good litter layer to preserve moisture during periods of drought.

It is not clear how the invasion of Kentucky bluegrass onto the site will affect the succession towards a rough fescue dominated community type. Observations from other rangeland reference areas have shown that rough fescue will succeed back into a Kentucky bluegrass dominated community type in 25-30 years (Willoughby 1995), but it took 36 years before rough fescue again dominated this site on the ungrazed inside transect.

It seems unlikely that this site will return to a community that is dominated solely by native species if properly managed. A rough fescue-Idaho fescue-Kentucky bluegrass dominated community type is probably the most stable community that can be achieved for this site.

SUMMARY

1.) The ungrazed inside transect appears to be succeeding to a Rough fescue-Kentucky bluegrass dominated community type.

2.) The grazed outside transect appears to be succeeding to a Kentucky bluegrass-Idaho fescue dominated community type.

3.) The desired plant community for the Carbondale River rangeland reference area is a Rough fescue-Idaho fescue dominated community type, but it seems unlikely that the site will return to a community that is dominated by native species because of the invasion of Kentucky bluegrass. As a result, range condition assessements will now have to be done based on Kentucky bluegrass as part of the community.

4.) The present range condition of the grazed rangeland at the Carbondale River rangeland reference area would be rated as fair and the trend for the site would be improving. This trend will likely continue as long as moisture does not become limiting.

LITERATURE CITED

Dept. of Environmental Protection. 1994. Natural Regions of Alberta. Dept. of Environmental Protection. Pub. no. I/531. 18pp.

Dyksterhuis, E.J. 1949. Condition and management of rangeland based on quantitative ecology. J. Range Manage. 2:104-115.

Gauch, H.G. 1982. Multivariate analysis in community ecology. Cambridge University Press, Cambridge, 298pp.

Hanson, A.R. 1975. Current range management on forest lands in Alberta. Alberta Energy and Natural Resources, Forest Service. Unpublished report. 79pp.

Irving, B.D. 1992. The effect of litter on the herbage growth cycle, soil water and soil temperature in the Aspen parkland of Alberta. M.Sc. Thesis, University of Alberta, Edmonton, Alberta.

Laycock, W.A. 1991. Stable states and thresholds of range condition on North American rangelands-a viewpoint. J. Range Manage. 45:427-433.

Moss, E.H. and J.A. Campbell. 1947. The fescue grassland of Alberta. Can. J. Res. 25:209-227.

Parker, K.W. 1954. A method for measuring trend in range condition on national forest ranges. U.S. Forest Service, Washington, D.C. 26pp.

Strong, W.L. 1992. Ecoregion and ecodistricts of Alberta. Vol. 1. Alberta Forestry, Lands and Wildlife, Land Information Services Division, Resource Information Branch, Edmonton, Alberta. T/244. 77pp.

Task Group on Unity in Concepts and Terminology. 1995. New concepts for assessement of rangeland condition. J. Range Manage. 48:271-283.

Ter Braak, C.J.F. 1986. Canonical Correspondence Analysis: A new eigenvector technique for multivariate direct gradient analysis. Ecology, 67:1167-1170.

Weerstra, B.G. 1989. Rangeland reference areas of the Alberta Forest Service. Range Management Section, Alberta Forest Service, Edmonton, Alta. 95pp.

Willoughby, M.G. 1992. Rangeland Reference Areas: Plant communities , ecology and repsonse to grazing in Division 1. Forestry, Lands and Wildlife, Alberta Forest Service. Pub. no. T/266. 44pp.

Willoughby, M.G., M.J. Alexander and K.M. Sundquist. 1997. Range plant communities and carrying capacity for the Montane subregion. Dept. of Environmental Protection. Forest Management Division. Edmonton, Alta. Pub. no. T/343. 146pp.

Willoughby, M.G. 1995. Rangeland Reference Areas: East Trout Creek, Range condition and trend 1953-1995. Dept. of Environmental Protection. Forest Management Division, Edmonton, Alta. Unpublished data.

Wroe, R.A., S. Smoliak, B.W. Adams, W.D. Willms and M.L. Anderson. 1988. Guide to Range condition and stocking rates for Alberta grasslands. Alberta Forestry, Lands and Wildlife. Edmonton, Alta. 33pp.

APPENDIX ONE

SPECIES COMPOSITION OF THE INSIDE AND OUTSIDE CLUSTER GROUPS OUTLINED IN FIGURE THREE.

VEGETATION REPORT GROUP NAME :1980'S OUT (GROUP 1) GROUP : 2

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average	CB800		CB830		CB860		CB890													
Layer	Value																				
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
2 poputre	25.0	00.1			00	.																
5 rosaaci	0100	00.7	01	.	00	.	01	.	00	.												
6 seladen	0100	45.1	44	.	46	.	33	.	57	.												
galibor	0100	02.0	02	.	01	.	02	.	04	.												
lithrud	0100	01.1	02	.	00	.	01	.	01	.												
hetevil	75.0	05.0	00	.			10	.	10	.												
achimil	75.0	02.3			05	.	03	.	02	.												
lupiser	75.0	02.3	06	.			02	.	02	.												
anemmul	75.0	02.2			01	.	02	.	06	.												
taraoff	75.0	01.0	01	.			02	.	02	.												
geumtri	75.0	00.8	01	.	03	.			00	.												
oxytspl	75.0	00.8	01	.			01	.	01	.												
antepar	75.0	00.1			00	.	00	.	00	.												
arniful	50.0	05.2					06	.	15	.												
agosgla	50.0	00.8					01	.	03	.												
geravis	50.0	00.7			02	.			01	.												
ceraarv	50.0	00.5					01	.	01	.												
dodecon	50.0	00.4	02	.					00	.												
phlohoo	50.0	00.3	01	.			00	.														
penscon	25.0	00.8			03	.																
violadu	25.0	00.6							02	.												
smilste	25.0	00.6			02	.																
heucric	25.0	00.4			02	.																
potegra	25.0	00.2			01	.																
allicer	25.0	00.1					01	.														
comaumb	25.0	00.1							00	.												
fragvir	25.0	00.0			00	.																
astralp	25.0	00.0							00	.												
caloapi	25.0	00.0							00	.												

VEGETATION REPORT GROUP NAME :1980'S OUT (GROUP 1) GROUP : 2

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average		CB800		CB830		CB860		CB890													
Layer	Value																					
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
delpbic	25.0	00.0							00	.												
poteans	25.0	00.0					00	.														
7 poa pra	0100	01.9	01	.	06	.	00	.	01	.												
festida	75.0	05.8	04	.			00	.	19	.												
careobt	75.0	02.1			00	.	03	.	05	.												
dantcal	75.0	01.7			02	.	02	.	03	.												
koelmac	75.0	01.5			00	.	03	.	03	.												
stipric	75.0	01.0			01	.	00	.	03	.												
festsca	75.0	00.4			01	.	00	.	01	.												
festsax	50.0	06.6			08	.	18	.														
agrotra	50.0	04.7	18	.			00	.														
poa com	25.0	00.0							00	.												

VEGETATION REPORT GROUP NAME :1950,60 AND 70'S IN AND OUT (GROUP 2) GROUP : 1

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number		Average		CB531		CB530		CB571		CB570		CB591		CB590		CB621		CB620		CB661		CB660		CB761	
Layer		Value																							
	Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
5	rosaaci	58.3	00.6	01	.			01	.	01	.	01	.			01	.	01	.						
6	seladen	0100	10.8	05	.	08	.	06	.	11	.	08	.	16	.	09	.	17	.	11	.	09	.	12	.
	galibor	91.7	01.7	02	.	03	.	01	.	02	.	02	.	02	.	03	.	02	.			01	.	01	.
	anemmul	75.0	01.1	02	.	01	.	01	.	01	.	01	.			01	.	02	.					01	.
	geumtri	66.7	01.0	02	.	03	.	01	.					01	.	01	.					01	.	01	.
	achimil	66.7	01.0	02	.	02	.	01	.	01	.	02	.			02	.					01	.		
	antepar	66.7	00.9	01	.	01	.	01	.							01	.	01	.			01	.	01	.
	solimis	41.7	00.5	01	.	01	.	01	.					01	.	01	.								
	potegra	33.3	00.4							01	.					01	.	01	.			01	.		
	hetevil	25.0	00.7			03	.			04	.							02	.						
	heucric	25.0	00.3							01	.							01	.						
	oxytspl	25.0	00.3			01	.			01	.														
	stellon	16.7	00.3																					02	.
	violadu	16.7	00.3																					02	.
	lupiser	16.7	00.3																	01	.	02	.		
	geraric	16.7	00.2			01	.	01	.																
	agosgla	08.3	00.1							02	.														
	arniful	08.3	00.1									01	.												
	artefri	08.3	00.1													01	.								
	artelud	08.3	00.1																					01	.
	cirsarv	08.3	00.1													01	.								
	geravis	08.3	00.1													01	.								
	lithrud	08.3	00.1																					01	.
	senepau	08.3	00.1			01	.																		
7	festida	0100	11.9	10	.	08	.	16	.	08	.	17	.	04	.	17	.	08	.	06	.	12	.	17	.
	careobt	0100	08.7	13	.	11	.	09	.	08	.	11	.	10	.	15	.	10	.	01	.	02	.	08	.
	koelmac	0100	04.7	07	.	05	.	05	.	08	.	02	.	03	.	03	.	06	.	02	.	01	.	05	.
	dantcal	0100	03.7	03	.	01	.	03	.	03	.	05	.	04	.	02	.	01	.	03	.	03	.	11	.
	stipric	91.7	03.4	05	.	04	.	04	.	04	.	04	.	04	.	07	.	05	.	01	.	01	.	01	.

VEGETATION REPORT GROUP NAME :1950,60 AND 70'S IN AND OUT (GROUP 2) GROUP : 1

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average		CB53I		CB53O		CB57I		CB57O		CB59I		CB59O		CB62I		CB62O		CB66I		CB66O		CB76I	
Layer	Value																							
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
festsca	83.3	02.1	01	.			01	.	01	.	02	.			01	.	01	.	08	.	05	.	04	.
agrotra	75.0	01.2	03	.	03	.	01	.	01	.	02	.	01	.	01	.	01	.					02	.
poa cus	58.3	01.4											02	.	01	.	03	.	02	.	03	.	03	.
calamon	41.7	01.0	06	.	03	.									01	.							01	.
juncbal	16.7	00.2																			01	.		
dantpar	08.3	00.2																					02	.
poa com	08.3	00.2							02	.														
poa pra	08.3	00.1																			02	.		
bromcil	08.3	00.1									01	.												
phlepra	08.3	00.1							01	.														

VEGETATION REPORT GROUP NAME :1950,60 AND 70'S IN AND OUT (GROUP 2) GROUP : 1

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average	CB760																					
Layer	Value																						
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
5 rosaaci	58.3	00.6	01	.																				
6 seladen	0100	10.8	16	.																				
galibor	91.7	01.7	01	.																				
anemmul	75.0	01.1	02	.																				
geumtri	66.7	01.0	01	.																				
achimil	66.7	01.0	01	.																				
antepar	66.7	00.9	03	.																				
heucric	25.0	00.3	01	.																				
oxytspl	25.0	00.3	01	.																				
stellon	16.7	00.3	02	.																				
violadu	16.7	00.3	01	.																				
delpbic	08.3	00.1	01	.																				
caloapi	08.3	00.1	01	.																				
dodecon	08.3	00.1	01	.																				
7 festida	0100	11.9	19	.																				
careobt	0100	08.7	06	.																				
koelmac	0100	04.7	11	.																				
dantcal	0100	03.7	07	.																				
festsca	83.3	02.1	02	.																				
poa cus	58.3	01.4	03	.																				
calamon	41.7	01.0	01	.																				
juncbal	16.7	00.2	01	.																				

VEGETATION REPORT GROUP NAME :1980 AND 90'S IN 1995 OUT (GROUP 3) GROUP : 3

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average		CB80I		CB83I		CB86I		CB89I		CB92I		CB95I		CB95O									
Layer	Value																							
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
5 rosaaci	71.4	01.0	01	.	01	.	03	.	01	.	01	.												
rosaark	14.3	00.0											00	.										
sympocc	14.3	00.0	00	.																				
6 anemmul	0100	06.5	03	.	06	.	07	.	13	.	13	.	04	.	01	.								
geumtri	0100	05.2	05	.	01	.	05	.	05	.	05	.	05	.	10	.								
galibor	0100	04.3	04	.	04	.	06	.	01	.	06	.	04	.	04	.								
achimil	0100	03.3	03	.	02	.	05	.	03	.	04	.	02	.	04	.								
lupiser	0100	02.8	04	.	03	.	03	.	03	.	02	.	01	.	03	.								
antelan	0100	01.4	01	.	00	.	01	.	02	.	02	.	03	.	01	.								
lithrud	0100	00.6	00	.	01	.	01	.	01	.	01	.	00	.	01	.								
artelud	85.7	01.9	03	.	02	.	02	.	02	.	02	.	03	.										
geravis	85.7	01.4	00	.	01	.	02	.	01	.			04	.	03	.								
caloapi	85.7	00.6			00	.	00	.	01	.	02	.	01	.	00	.								
seladen	71.4	01.1	00	.	01	.	01	.	06	.	01	.												
smilste	71.4	01.1			00	.			00	.	00	.	01	.	07	.								
agosgla	71.4	00.8					00	.	00	.	01	.	01	.	03	.								
dodecon	71.4	00.4	00	.					00	.	00	.	01	.	01	.								
ceraarv	71.4	00.3					00	.	01	.	00	.	00	.	01	.								
arniful	57.1	01.0					01	.	01	.			02	.	03	.								
antepar	57.1	00.3			01	.			00	.			00	.	01	.								
ziziapt	42.9	00.9									01	.	02	.	03	.								
camprot	42.9	00.1									00	.	01	.	00	.								
solimis	42.9	00.1					01	.	00	.	00	.												
comaumb	42.9	00.1							00	.	00	.	00	.										
viciame	28.6	00.7											00	.	05	.								
heucric	28.6	00.1			00	.			01	.														
allicer	28.6	00.1					00	.	00	.														
taraoff	14.3	01.0													07	.								
geraric	14.3	00.4									03	.												

VEGETATION REPORT GROUP NAME :1980 AND 90'S IN 1995 OUT (GROUP 3) GROUP : 3

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average	CB80I		CB83I		CB86I		CB89I		CB92I		CB95I		CB95O							
Layer	Value																				
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
violadu	14.3	00.3							02	.												
asteeri	14.3	00.2													01	.						
monafis	14.3	00.1											01	.								
sisymon	14.3	00.1									01	.										
lathoch	14.3	00.0											00	.								
zigaele	14.3	00.0									00	.										
delpbic	14.3	00.0													00	.						
gailari	14.3	00.0													00	.						
hetevil	14.3	00.0			00	.																
penscon	14.3	00.0					00	.														
tragdub	14.3	00.0													00	.						
7 dantcal	0100	08.0	25	.	03	.	03	.	06	.	13	.	01	.	04	.						
festida	85.7	08.9	00	.			03	.	09	.	30	.	09	.	12	.						
festsca	85.7	07.0	01	.	01	.	05	.	14	.	14	.	14	.								
stipric	85.7	05.4	09	.	02	.	01	.	08	.	14	.	04	.								
careobt	85.7	03.8			00	.	02	.	02	.	10	.	05	.	08	.						
agrotra	85.7	02.2	04	.	00	.	00	.			02	.	05	.	04	.						
poa pra	71.4	08.8	10	.			02	.	00	.	10		15	.	20	.						
koelmac	71.4	01.2			00	.	04	.	01	.	02	.			01	.						
festsax	28.6	02.7			08	.	11	.														
brompum	14.3	00.5													03	.						
dantpar	14.3	00.3									02	.										
agrodas	14.3	00.2									01	.										
bromcil	14.3	00.0											00	.								
junccon	14.3	00.0											00	.								

VEGETATION REPORT GROUP NAME :NEW TRANSECT OUTSIDE CARBONDALE GROUP : 1

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average		CBN860		CBN890		CBN920		CBN950													
Layer / Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
2 poputre	25.0	00.0					00	.														
5 rosaaci	25.0	00.0					00	.														
rosaark	25.0	00.0							00	.												
6 achimil	0100	09.4	16	.	11	.	07	.	05	.												
geumtri	0100	06.5	04	.	08	.	05	.	09	.												
smilste	0100	04.7	03	.	10	.	02	.	05	.												
galibor	0100	01.6	02	.	00	.	03	.	02	.												
potegra	0100	01.0	01	.	01	.	01	.	01	.												
antepar	0100	00.5	01	.	00	.	00	.	01	.												
fragvir	0100	00.3	00	.	00	.	01	.	01	.												
caloapi	0100	00.3	00	.	00	.	01	.	00	.												
geravis	75.0	03.4	03	.	05	.			06	.												
anemmul	75.0	00.9	01	.	00	.			03	.												
ceraarv	75.0	00.8	01	.	02	.			01	.												
camprot	75.0	00.7			00	.	00	.	03	.												
taraoff	75.0	00.4	00	.			00	.	02	.												
penscon	75.0	00.2	01	.	00	.			00	.												
heucric	50.0	01.0	04	.	00	.																
ziziapt	50.0	01.0					01	.	03	.												
antelan	50.0	00.8					03	.	01	.												
monafis	50.0	00.7			01	.			02	.												
tragdub	50.0	00.1			00	.	00	.														
sisymon	50.0	00.0			00	.	00	.														
zigaele	50.0	00.0					00	.	00	.												
geraric	25.0	01.9					08	.														
violadu	25.0	00.8			03	.																
arniful	25.0	00.2							01	.												
lithrud	25.0	00.2					01	.														
viciame	25.0	00.2							01	.												

VEGETATION REPORT GROUP NAME :NEW TRANSECT OUTSIDE CARBONDALE GROUP : 1

RESOURCE INVENTORY, EDMONTON ALBERTA

Plot Number	Average	CBN860		CBN890		CBN920		CBN950													
Layer	Value																				
Species	% P	MC	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg	Cv	Vg
agosgla	25.0	00.2					01	.														
solimis	25.0	00.1	01	.																		
dodecon	25.0	00.1							00	.												
lomatri	25.0	00.1					00	.														
penspro	25.0	00.1					00	.														
drabnem	25.0	00.0			00	.																
allicer	25.0	00.0			00	.																
anempat	25.0	00.0					00	.														
cirsarv	25.0	00.0							00	.												
7 poa pra	0100	29.7	22	.	26	.	34	.	37	.												
festida	0100	09.3	03	.	14	.	14	.	06	.												
dantcal	0100	06.4	02	.	06	.	13	.	05	.												
stipric	0100	04.6	01	.	02	.	13	.	03	.												
careobt	0100	04.2	03	.	06	.	03	.	04	.												
koelmac	0100	03.0	04	.	06	.	02	.	01	.												
agrotra	0100	02.3	01	.	00	.	02	.	07	.												
festsca	0100	01.0	01	.	01	.	01	.	01	.												
bromcil	75.0	00.1			00	.	00	.	00	.												
festsax	25.0	01.4	06	.																		
stipvir	25.0	00.6					02	.														
poa nem	25.0	00.4							02	.												
brompum	25.0	00.1							00	.												
phlepra	25.0	00.1					00	.														
junclon	25.0	00.0							00	.												